CHAPTER 1 – CHEMICAL REACTIONS AND EQUATIONS

1. Daily-Life Situations Showing Chemical Change

These everyday events indicate that a **chemical reaction** has occurred:

Situation	What Happens	Reason
Milk left in summer	Turns sour	Microbial action → new substances
Iron tawa/pan/nail in humid air	Rusting	Formation of **iron oxide**
Grapes ferment	Alcohol formation	Biochemical reaction
Food is cooked	New substances formed	Heat enables chemical change
Digestion	Food breaks into simpler molecules	Enzymatic reactions
Respiration	Glucose → CO_2 + H_2O + Energy	Oxidation reaction

A **chemical reaction** = formation of one or more *new* substances with changed identity.

2. How Do We Know a Chemical Reaction Has Occurred?

Key indicators:

1. **Change in state**
2. **Change in colour**
3. **Evolution of gas**
4. **Change in temperature**

Example:
Burning magnesium ribbon → dazzling white flame + white **MgO** powder.

3. Word Equations → Chemical Equations

Word Equation Example

Magnesium + Oxygen → Magnesium oxide

Chemical Equation

$Mg + O_2 \rightarrow MgO$

- Shows **reactants** → **products**.

4. Skeletal & Balanced Chemical Equations

Skeletal Equation

Unbalanced form:
$Mg + O_2 \rightarrow MgO$

Need to Balance

- Follows **Law of Conservation of Mass**
- Atoms of each element must be equal on both sides

SAMPLE NOTES

5. Balancing Chemical Equations – Key Procedure

Example:

$Fe + H_2O \rightarrow Fe_3O_4 + H_2$

Balancing steps:

1. **Count atoms** of each element on both sides.
2. **Balance one element at a time**, usually the most complex compound first.
3. **Never change formulas**, only use *coefficients*.
4. Apply hit-and-trial method.

Final **balanced equation**:

$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

6. Physical States in Chemical Equations

Symbols:

- (s) = solid
- (l) = liquid
- (g) = gas
- (aq) = aqueous (dissolved in water)

Example:

$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$

7. Reaction Conditions

Written above/below arrow:

Example:

$CO + 2H_2 \rightarrow CH_3OH$ (at 340 atm)

Photosynthesis:

$6CO_2(aq) + 12H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6O_2(aq) + 6H_2O(l)$

(Chlorophyll, Sunlight)

8. Types of Chemical Reactions (Intro)

A. Combination Reaction

Two or more reactants → **one product**.

Example:

$CaO + H_2O \rightarrow Ca(OH)_2 + heat$

- Highly exothermic

Other examples given later in chapter:

- $C + O_2 \rightarrow CO_2$
- $2H_2 + O_2 \rightarrow 2H_2O$

SAMPLE NOTES

SUPER QUICK RECAP TABLE

Concept	Key Points
Indicators of Reaction	State, colour, gas, temperature change
Word → Chemical Equation	Replace words with formulae
Balanced Equation	Follows conservation of mass
Physical States	(s), (l), (g), (aq)
Combination Reaction	Many reactants → one product

1.1 CHEMICAL EQUATIONS – REVISION NOTES

1. What Is a Chemical Equation?

A **chemical equation** is the symbolic representation of a chemical reaction using **chemical formulae** instead of words.

Word Equation Example

Magnesium + Oxygen → Magnesium oxide

Chemical Equation (Skeletal Form)

$Mg + O_2 \rightarrow MgO$

- This is a **skeletal equation** because atoms are not yet balanced.

2. Components of a Chemical Equation

Term	Meaning
Reactants	Substances that undergo chemical change (LHS)
Products	New substances formed (RHS)
Arrow (→)	Direction of reaction (reactants → products)

3. Skeletal vs Balanced Chemical Equation

Skeletal Chemical Equation

- Uses correct chemical formulae
- **Atoms not balanced**
  Example: $Mg + O_2 \rightarrow MgO$

Balanced Chemical Equation

- Follows **Law of Conservation of Mass**
- Number of atoms of each element is equal on both sides

SAMPLE NOTES

4. Balancing Chemical Equations (Hit-and-Trial Method)

Law of Conservation of Mass

"Mass can neither be created nor destroyed."

→ Total atoms of each element must be equal on both sides.

5. Example: Zinc + Sulphuric Acid

Word Equation

Zinc + Sulphuric acid → Zinc sulphate + Hydrogen

Chemical Equation

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

- Check atoms: all balanced

6. Detailed Balancing Example

Unbalanced Equation

$Fe + H_2O \rightarrow Fe_3O_4 + H_2$

Balancing Steps (Hit-and-Trial)

1. **Count atoms** on both sides.
2. **Start with the most complex molecule** → Fe_3O_4
3. Balance O by placing **$4H_2O$**
4. Balance H by making **$4H_2$**
5. Balance Fe by making **3Fe**

Final Balanced Equation

$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

7. Writing State Symbols

Symbol	Meaning
(s)	solid
(l)	liquid
(g)	gas
(aq)	aqueous (dissolved in water)

Example:

$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$

SAMPLE NOTES

8. Reaction Conditions

Conditions like **temperature, pressure, catalyst** may be written over/below the arrow.

Examples:

- $CO + 2H_2 \rightarrow CH_3OH$ (340 atm)
- Photosynthesis:
  $6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$
  (Chlorophyll, Sunlight)

1.2 TYPES OF CHEMICAL REACTIONS

A **chemical reaction** involves **breaking and making of bonds** to form new substances.
NCERT describes the following key reaction types:

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1. Combination Reaction

Definition:
Two or more reactants combine to form **one product**.

General form:

$A + B \rightarrow AB$

NCERT Example:

$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq) + Heat$
(Quick lime) (Slaked lime)

- Highly **exothermic** (beaker becomes hot)

Other NCERT Combination Examples:

1. **Burning of coal:**
   $C(s) + O_2(g) \rightarrow CO_2(g)$
2. **Formation of water:**
   $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
3. **Rusting (slow combination):**
   $3Fe + 4H_2O + O_2 \rightarrow Fe_3O_4 + 4H_2$

2. Decomposition Reaction

Definition:
A single reactant breaks down to form **two or more products**.

Types:

- Thermal decomposition (heat)
- Electrolytic decomposition (electricity)
- Photochemical decomposition (light)

SAMPLE NOTES

3. Displacement Reaction

Definition:

A more reactive element **displaces** a less reactive element from its compound.

General form:

A + BC → AC + B

4. Double Displacement Reaction

Definition:

Exchange of ions between two compounds to form **new compounds**.

General form:

AB + CD → AD + CB

Includes:

- **Precipitation reactions**
- **Neutralisation reactions**

5. Oxidation and Reduction (Redox Reactions)

Defined later in the same section:

- **Oxidation:** gain of oxygen / loss of hydrogen
- **Reduction:** loss of oxygen / gain of hydrogen
- Often occur **simultaneously**.

EXAM-ORIENTED QUICK TABLE

Reaction Type	Key Feature	Example
Combination	2+ reactants → 1 product	$CaO + H_2O \rightarrow Ca(OH)_2$
Decomposition	1 reactant → 2+ products	$CaCO_3 \rightarrow CaO + CO_2$
Displacement	Reactive element displaces less reactive	$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
Double Displacement	Ion exchange	$AgNO_3 + NaCl \rightarrow AgCl\downarrow + NaNO_3$
Redox	Oxidation + reduction	$CuO + H_2 \rightarrow Cu + H_2O$

SAMPLE NOTES

1.2.1 COMBINATION REACTION

Definition

A reaction in which **two or more reactants combine** to form **a single product**.

General Form:

A + B → AB

Key NCERT Example (Activity 1.4)

$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq) + Heat$

(Quick lime) (Slaked lime)

- Reaction is **exothermic** (beaker becomes hot).

Other NCERT Stated Examples

1. **Burning coal:**
   $C + O_2 \rightarrow CO_2$
2. **Formation of water:**
   $2H_2 + O_2 \rightarrow 2H_2O$
3. **Rusting (slow combination):**
   $3Fe + 4H_2O + O_2 \rightarrow Fe_3O_4 + 4H_2$

1.2.2 DECOMPOSITION REACTION

Definition

A reaction in which **one reactant breaks down** to form **two or more products**.

General Form:

AB → A + B

Three types based on energy source:

A. Thermal Decomposition (heat)

Heat energy splits the compound.

NCERT Example (Activity 1.5):

$2Pb(NO_3)_2(s) \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$

- **Brown fumes** of NO_2 observed.

B. Electrolytic Decomposition (electricity)

Electric current breaks the compound.

NCERT Example (Activity 1.6):

$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$

- Decomposition in voltameter.

SAMPLE NOTES

C. Photochemical Decomposition (light)

Light energy breaks the substance.

NCERT Example (Activity 1.7):

$2AgCl(s) \rightarrow 2Ag(s) + Cl_2(g)$

- Occurs in **sunlight**, Ag turns **grey**.

1.2.3 DISPLACEMENT REACTION

Definition

A reaction where **a more reactive element displaces a less reactive one** from its compound.

General Form:

A + BC → AC + B
(where A is more reactive than B)

NCERT Example (Activity 1.9):

$CuSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Cu(s)$

- **Blue** $CuSO_4$ solution becomes **colourless**.
- Brown copper metal deposits on zinc.

Other NCERT Examples:

- $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
- $Zn + FeSO_4 \rightarrow ZnSO_4 + Fe$

1.2.4 DOUBLE DISPLACEMENT REACTION

Definition

A reaction in which **exchange of ions** occurs between two compounds.

General Form:

AB + CD → AD + CB

Key NCERT Focus: Precipitation Reaction

Two aqueous solutions react → **insoluble solid (precipitate)** forms.

NCERT Example (Activity 1.10):

$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) \downarrow + 2NaCl(aq)$

- White insoluble precipitate of **$BaSO_4$** forms.

Neutralisation Reaction (special case)

Acid + Base → Salt + Water
Example:
$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

SAMPLE NOTES

1.2.5 OXIDATION AND REDUCTION (REDOX REACTIONS)

Definition per NCERT

Oxidation

- Gain of **oxygen**
- Loss of **hydrogen**
- Loss of electrons (in advanced chemistry)

Reduction

- Loss of **oxygen**
- Gain of **hydrogen**

NCERT Example:

$CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(g)$

Substance	Oxidation / Reduction
$CuO \rightarrow Cu$	**Reduction** (loss of oxygen)
$H_2 \rightarrow H_2O$	**Oxidation** (gain of oxygen)

Hence this is a **redox reaction** (both oxidation & reduction occur simultaneously).

EXAM-READY SUMMARY TABLE

Reaction Type	Key Idea	NCERT Example
Combination	2+ reactants → 1 product	$CaO + H_2O \rightarrow Ca(OH)_2$
Decomposition	1 reactant → multiple products	$2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$
Displacement	More reactive displaces less reactive	$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
Double Displacement	Ion exchange, precipitate forms	$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4\downarrow + NaCl$
Redox	Oxidation + reduction together	$CuO + H_2 \rightarrow Cu + H_2O$

SAMPLE NOTES

1.3 EFFECTS OF OXIDATION REACTIONS IN DAILY LIFE

Oxidation reactions occur all around us and often cause **damage** to materials or food.
NCERT highlights two major effects:

1.3.1 CORROSION

Definition

Corrosion is the **gradual deterioration of metals** due to reaction with air, moisture, or other chemicals.

Most Common Example: Rusting of Iron

Iron reacts with **oxygen + moisture** to form **hydrated iron(III) oxide (rust)**.

Reaction:

$4Fe + 3O_2 + 2xH_2O \rightarrow 2Fe_2O_3 \cdot xH_2O$

Characteristics of Rusting

- Brown, flaky coating
- Weakens metal
- Accelerated in salty or humid conditions

Corrosion of Other Metals

- **Copper:** Forms green coating of basic copper carbonate
- **Silver:** Turns black due to silver sulphide formation
- **Aluminium:** Forms protective aluminium oxide layer

Prevention of Corrosion

- Painting
- Oiling/greasing
- Galvanisation (Zn coating)
- Alloying (e.g., stainless steel)
- Electroplating

1.3.2 RANCIDITY

Definition

Rancidity is the process in which **oily and fatty foods get oxidised**, leading to:

- **Foul smell**
- **Bad taste**
- **Colour change**

This is caused by **oxidation of fats and oils** when exposed to **air, light, or moisture**.

Examples

- Chips or fried snacks smell bad if kept open.
- Ghee/oil changes taste when old.

SAMPLE NOTES

Prevention of Rancidity

NCERT methods include:

1. Antioxidants

Added to food to slow oxidation.
Example: BHA, BHT.

2. Airtight Packaging

Excluding oxygen slows the reaction.

3. Flushing with Nitrogen Gas

Packaged chips use **N_2 gas** to prevent oxidation.

4. Refrigeration

Slows oxidation rate.

5. Keeping Away From Light

Opaque containers reduce photochemical oxidation.

EXAM-READY COMPARISON TABLE

Feature	Corrosion	Rancidity
Occurs in	Metals	Food (fats & oils)
Cause	Oxidation by air/moisture	Oxidation of fats/oils
Result	Damage, weakening, rusting	Bad smell, bad taste
Prevented by	Galvanising, painting, alloying	Refrigeration, antioxidants, N_2 flushing
NCERT Example	Rusting of iron	Chips in nitrogen packets

SUPER QUICK SUMMARY

- Oxidation reactions can be **harmful** in daily life.
- **Corrosion** damages metals; needs protection.
- **Rancidity** spoils food; prevented using antioxidants, nitrogen packing, etc.

SAMPLE NOTES